Exhibit 1

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

GARY KOOPMANN, TIMOTHY KIDD and VICTOR PIRNIK, Individually and on Behalf of All Others Similarly Situated, Plaintiffs, v. FIAT CHRYSLER AUTOMOBILES N.V., FCA US, LLC, SERGIO MARCHIONNE, RICHARD K. PALMER, SCOTT KUNSELMAN, MICHAEL DAHL, STEVE MAZURE and ROBERT E. LEE Defendants.	**Civ. Action No: 15-cv-07199-JMF** **CLASS ACTION**

EXPERT REPORT OF Dr. AXEL FRIEDRICH.

August 15, 2018

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I. Background and Qualifications

1. I have a Ph.D. in engineering from the Technical University of Berlin and have been involved with vehicle emissions and emissions standards for the majority of my career. I spent nearly 30 years with the Federal Environment Agency of Germany (the "UBA") working extensively on vehicle emissions and emissions legislation and regulation. In 1994, I was appointed as the head of the newly-formed Transport and Environment Division within the UBA. In this position, together with my staff, I developed the UBA proposals for the emissions standards which became implemented as Euro 3, Euro 4, Euro 5 and Euro 6. I was involved in the development of the German proposals for these standards, as well as being involved in negotiations regarding the standards at the European Union level. As part of UBA's work, and in the development of emissions control proposals, UBA did significant amounts of modelling of emissions and air quality in real life situations. During my time at UBA, I was aware of, and involved in several investigations that revealed that defeat devices were used by car companies. I retired from my position at the UBA on 30 June 2008. Since that time, I have been self-employed as a Consultant. I have undertaken various activities during this time, including advising foreign governments, advising NGOs, and undertaking my own research into emissions and other environmental issues. In 2001, I am a founding member of the International Council for Clean Transport ("ICCT"). The mission of the ICCT was to propagate solutions for the reduction of emissions and greenhouse gas, and to bring collaboration between governments around the world on these issues. The ICCT has since developed into a think-tank, with the same focus.

2. My current hourly rate is $320 per hour for all work and travel time. My compensation is not contingent on the outcome of this litigation.

II. Scope of Engagement

3. I have been retained by Counsel for Plaintiffs in this matter to opine as to whether Fiat Chrysler Automobiles N.V. ("FCA" or the "Company") was in compliance with European Union ("EU") emissions regulations during the Class Period. I have also been asked to evaluate the adequacy of the Company's disclosures concerning its compliance with EU emissions regulations.

4. Attached to this report are the following exhibits:

i. A copy of my curriculum vitae (Exhibit 1)

ii. A listing of cases in which I have testified as an expert at trial or by deposition during the past four years (Exhibit 2)

iii. A listing of relevant publications that I have authored or co-authored within the last years (Exhibit 3)

iv. A listing of material that I considered in formation of my opinions (Exhibit 4)

v. A listing of FCA vehicles I tested (Exhibit 5)

III. Bases for Opinions

5. My opinions are based upon my professional knowledge and experience, my review of documents and information relevant to this matter, my testing of certain vehicles, which was conducted for the German Non-Government Organization "Deutsche Umwelthilfe" ("DUH"), and the analyses described in this Report and its Exhibits. Documents, data, and other information that I have relied upon as bases for my opinions are cited in this Report and its Exhibits. Such documents and information are typically relied upon by me in my prior expert

and consulting work, by emissions regulators when evaluating compliance and by academics in their research.

6. Counsels for Plaintiffs have informed me that the record in this matter continues to be developed. I expect to review additional facts that may become available through discovery as well as the reports and depositions of other expert witnesses. The opinions offered in this Report are subject to refinement or revision based on continuing analysis of the documents and information listed above, as well as new or additional information that may be provided to or obtained by me in the course of this matter.

IV. Summary of Opinions

7. Based on my review of the available evidence in this matter and careful analysis of relevant regulations, and as more fully discussed below, I conclude that

i. FCA was not in compliance with the EU emissions regulations during the Class Period.

ii. FCA's statements concerning its compliance with emissions regulations were false and misleading.

V. Overview of FCA's Operations

8. FCA is an automotive group that designs, engineers, manufactures, distributes and sells vehicles and components. It offers passenger cars, light trucks, and light commercial vehicles under brand names including Chrysler, Dodge, Fiat, Jeep, and Ram. The Company sells its products directly, or through distributors and dealers, in approximately 150 countries. The Company was founded in October 2014 as the result of a merger that completed the integration of Fiat and Chrysler Group LLC.

9. In particular, FCA sells the following diesel engine vehicles in the EU: a. Fiat 500, 1,3 l Diesel, b. Fiat 500L, 1.3 l Diesel, c. Fiat 500L Trekking, 1,3 l Diesel, 16,l Diesel, d. Fiat 500X, 1,3 l Diesel, 1,6 l Diesel, 2,9 l Diesel, e. Fiat Doblò, 1,6 l 70 kW, 1,6 l 88 kW, f. 2,0 l 85 kW, 2,3 l 96 kW, 2,3, l 109 kW, 2,3 l 130 kW, g. Fiat Qubo, 13, 3 l diesel, Fiat Tipo, 1,3 l Diesel, Fiat Punto. 1,3 l Diesel, h. Fullback, 2,4 l 113 kW, 2,4,l 133 kW, Fiat Panda, 1,3 l Diesel, i. Fiat Talento, 1,6 l 92 kW, 1,6 l 107 kW, 1,6 l 92 kW j. Fiat Ducato, 2,0 l 85 kW, 2,3 l 96 kW, 2,3 l 110 kW, 2,3 l 130 kW, k. Fiat Fiorino, 1,3 l 59 kW, 1,3 l, i. Alfa Romeo Stelvio, 2,2 l diesel, 147 kW, 2,2 l 206 kW m. Alfa Romeo Gulia 2,2 l 100 kW, 2.2 l 110 kW, 2,2,l 132 kW, 2,3 l 154 kW, n. Alfa Romeo Giulietta 1,6 l 88 kW, 2,0 l 110 kW, 2,0 129 kW, Alfa Romeo Mito, 1,3 l diesel 70 kW, p. Jeep Compass, 2,0 l 125 kW, 2,0 l 103 kW, q. Jeep Wrangler 2,2 l 147 kW r. Jeep Renegate 2,0 l 103 kW, 2,0 l 125 kW, 1,6 l 70 kW, 1,6 l 88m kW, s. Jeep Cherokee, 2,2, l Diesel 136 kW, 2,0 l 103 kW, 2,2 l 147 kW.

VI. <u>Background</u>

A. <u>NOx and why it is regulated</u>

10. Nitrogen dioxide affects the respiratory system directly, but also contributes to the formation of particles and ozone. Nitrogen dioxide causes a range of harmful effects on the lungs, including:

- Increased inflammation of the airways;
- Worsened cough and wheezing;
- Reduced lung function;
- Increased asthma attacks; and
- Greater likelihood of emergency department and hospital admissions.
- New research indicates that NO2 is likely to be a cause of asthma in children.

11. Outdoor air concentrations of nitrogen dioxide (NO2) in Germany have a serious impact on health according to a study by the German Environment Agency (UBA). Statistics for

2014 indicate roughly 6,000 premature deaths due to cardiovascular diseases which are linked to background concentrations of NO2 in both rural and urban areas. The study also shows that nitrogen dioxide pollution is associated with diseases such as diabetes mellitus, hypertension, stroke, chronic obstructive pulmonary disease (COPD) and asthma. UBA President Maria Krautzberger said: "The study proves how harmful nitrogen dioxide is to health in Germany. We must take every measure possible to ensure that our air is clean and healthy. The need for action is particularly urgent in cities with heavy traffic, a fact which the Federal Administrative Court has confirmed. There is even talk of imposing driving bans as a last resort."

12. The European ESCAPE studies have reported statistically significant associations between long-term exposure to NO2 and lung function in children, respiratory infections in early childhood and effects on adult lung function.

13. The study points out that eight per cent of the existing cases of diabetes mellitus in Germany in 2014 are linked to nitrogen dioxide exposure in outdoor air. That means that about 437,000 people are suffering the disease. For existing cases of asthma, the percentage of cases which can be traced to NO2 pollution is even higher: around 14 per cent, or about 439,000 cases.

14. Although epidemiological studies do not allow drawing conclusions about causal relationships, they do deliver a great deal of consistent results about the statistical correlations between negative health effects and NO2 exposure.

15. Emissions of non-methane volatile organic compounds (NMVOCs), nitrogen oxides, carbon monoxide and methane contribute to the formation of ground-level (tropospheric) ozone.

16. Ozone is a powerful oxidant and tropospheric ozone can have adverse effects on human health and ecosystems. It is a problem mainly during the summer months. High concentrations of ground-level ozone adversely affect the human respiratory system and there is evidence that long-term exposure accelerates the decline in lung function with age and may impair the development of lung function. Some people are more vulnerable to high concentrations than others, with the worst effects generally being seen in children, asthmatics and the elderly. High concentrations in the environment are harmful to crops and forests, decreasing yields, causing leaf damage and reducing disease resistance.

17. Nitrogen oxides (NOx, the sum of nitrogen monoxide (NO) and NO2) and NH3 emissions disrupt terrestrial and aquatic ecosystems by introducing excessive amounts of nutrient nitrogen. This leads to eutrophication, which is an oversupply of nutrients that can lead to changes in species diversity and to invasions of new species. NH3 and NOx, together with SO2, also contribute to the acidification of soil, lakes and rivers, causing biodiversity loss. Finally, ground-level O3 damages agricultural crops, forests and plants by reducing their growth rates.

18. Based on the knowledge of the harmful impact of NOx, especially NO2, the EU has adopted air quality guidelines for the ambient concentrations of NO2 and Ozone. Member states have to develop action plans to meet these limits. The annual mean concentration limit for NO2 is 40 microgram /m3. Nearly at all monitoring stations in the EU, which are located in the vicinity of roads, this air quality standard was violated at the beginning of the century by far. At most stations the main cause of violation of the NO2 air quality standard is traffic and especially cars (about 70 to 80%)

19. The EU has also adopted NOx emission limits for stationary sources like power plants. Emission standards for trucks and light duty vehicles were also introduced in the eighties

and these standards were reduced in steps from EURO 1 up to EURO 6 in order to meet the EU air quality standards.

20. The emission standards were different for gasoline and Diesel vehicles due to heavy lobby work of the vehicle industry in Brussels at EU level and in the member states of the EU. Below are the relevant emission standards for Diesel (and gasoline) vehicles. The NOx emission standards are expressed in g/km. For example, the NOx emission limit for Diesel engines under EU 4 (effective January 2005) was 0.25 g/km (250 mg/km). The NOx emission limit for Diesel engines under EU 6 (effective September 2014) was reduced to 0.080 g/km (80 mg/km). Vehicles that emit NOx emissions at a level higher than the limit imposed by the applicable regulation (e.g. EU 5 or EU 6) violate the regulation.

Tier	Date	CO	THC	NMHC	NO_x	$HC+NO_x$	PM	PN [#/km]
Diesel								
Euro 4	January 2005	0.50	-	-	0.25	0.30	0.025	-
Euro 5a	September 2009	0.50	-	-	0.180	0.230	0.005	-
Euro 5b	September 2011	0.50	-	-	0.180	0.230	0.005	6×10^{11}
Euro 6	September 2014	0.50	-	-	0.080	0.170	0.005	6×10^{11}
Petrol (Gasoline)								
Euro 4	January 2005	1.0	0.10	-	0.08	-	-	-
Euro 5	September 2009	1.0	0.10	0.068	0.060	-	0.005**	-
Euro 6	September 2014	1.0	0.10	0.068	0.060	-	0.005**	6×10^{11}***

21. The definition of the EU 6 standards was based on model calculations. From the highest NO2 concentrations in street canyons the necessary level of the emission standards was calculated to meet the NO2 air quality standard. It was therefore expected with adoption of the EU 5 and EU 6 emission standards for cars and trucks at most of the monitoring stations in the EU the air quality limit for NO2 would be met in 2015. But still today a large number of monitoring stations in the vicinity of roads exceed the yearly NO2 standard of 40 microgram per

m3 by far. As passenger diesel cars contribute about 70 to 75 % to the concentrations of NO2 on most traffic monitoring stations, the fact that diesel cars have much higher emissions in the real world than at laboratory tests is the key factor for exceedance of the NO2 air quality standard at many traffic located monitoring stations.

B. NOx Emissions Controls (EGR, SCR and LNT)

22. Nitrogen oxides (NOx) are created in the combustion chamber at high temperature by thermal dissociation and recombination of Oxygen and Nitrogen molecules, both of which are in our air. The higher the temperature the higher is the formation of Nitrogen Oxide.

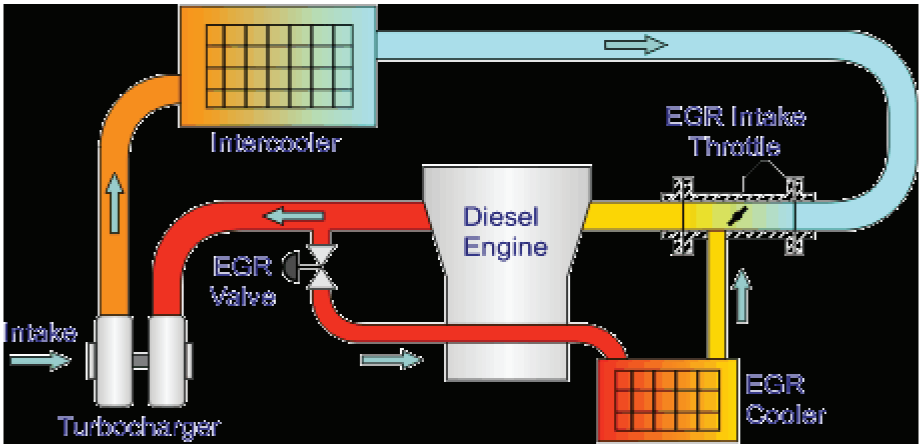
23. There are three different emission reduction technologies available, 1) Exhaust gas recirculation (EGR), 2) lean NOx trap (LNT), and 3) selective catalytic reduction (SRC). These three possibilities have distinct advantages and disadvantages.

1. Exhaust Gas Recirculation (EGR)

24. EGR means recirculation of exhaust gas into the intake air. The oxygen concentration in the combustion chamber is reduced during the combustion. As a result, the peak temperature is reduced and as a consequence the formation of nitrogen oxide is suppressed.

25. A valve is used to control the flow of gas and the valve can be closed to reduce the gas recirculation to zero.

26. When the emission limits in Europe were reduced by the introduction of Euro 4 standards (250 mg/km NOx), EGRs were used widely. The reduction of the emission limit by EURO 5 (180 mg/km) lead to a widespread use of cooled EGR. The cooling of the exhaust gas allows more gas recirculation. The principle of the EGR system is shown in graph No. 1.



27. In order to control the amount of the gas recirculation, signals from sensors are required. The signals of these sensors are handled in the electronic control unit, the "computer heart", of the vehicle. Sensors for temperature, back pressure or air flow are used. In addition a position sensor is required by the OBD regulation.

28. The advantage of EGR is the low price compared to other NOx reduction technology. The International Council for Clean Transport, (ICCT) estimated that the additional cost for an EGR is 142 US$ for a 2 l engine in 2015.

29. But the dilution of the combustion mixture reduces the efficiency of the combustion. This means that fuel consumption can be increased and engine power reduced. The formation of Diesel particles also increases. The particle filter captures these particles completely but the particle filter has to be regenerated more often, which also increases the fuel consumption.

30. Deposits can be formed on the EGR valve and can lead to drivability problems.

31. Emission reduction of NOx is limited by these negative effects. Normally a 30% to 40 % reduction is achieved at low load with limited negative consequences.

2. **Selective Catalytic Reduction (SCR)**

32. SCR has been used in power plants for more than 40 years. It was introduced in trucks in Europe by Daimler, MAN and Iveco to meet the more stringent NOx emission standards of EURO V for trucks (2g/KWh).

33. On a catalyst NOx is converted with ammonia to nitrogen and water. As ammonia is toxic urea is used as a source of ammonia in the road transport sector. Urea is injected to a urea decomposition catalyst to form ammonia. The 32.5 % aqueous urea solution is marketed under the brand name AdBlueto. The main chemical reaction is:

$$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$$

$$2NO_2 + 4NH_3 + O_2 \rightarrow 3N_2 + 6H_2O$$

$$NO + NO_2 + 2NH_3 \rightarrow 2N_2 + 3H_2O$$

34. The advantage of SCR is the high conversion rate for NOx – more than 90% can be achieved – and the high durability of the catalyst. The main disadvantage is the higher cost for the system. ICCT estimated the additional cost for a **2 l diesel engine is 418 US$**. Other disadvantages are that a tank for the urea has to be installed, and it can sometimes be difficult to find sufficient space for it. And the urea tank also has to be refilled regularly. The amount of urea needed to reduce NOx emission by 90% is 3-5% of the diesel fuel consumption, depending on the drive pattern and drive style. To avoid ammonia emissions to the ambient air an additional catalyst is needed after the SCR catalyst to destroy possible excess ammonia.

35. As a catalyst has to be warmed up to an operation temperature (> 180 degree C), the performance isn't good after a cold start. So, the manufacture can use different engine strategies to shorten the warm up period or the manufacturer can use a lean NOx trap.

3. Lean NOx Trap (LNT)

36. A lean NOx trap adsorbs NOx on Barium oxide storage in the exhaust. When the catalyst is saturated, the storage system can't adsorb additional NOx. The system has to be regenerated in short periods of fuel-rich operation (lower air to fuel ratio). The NOx is reduced by a "conventional" three way catalyst. The storage of the NOx is temperature dependent. At low temperature the storage is very good; at high temperature the stored NOx is desorbed. At low speed and low temperature the efficiency of the NOx removal can be up to 90%. At the regeneration the engine has to run rich (lower air to fuel ratio). This has two main disadvantages: 1) it increase the fuel consumption, and 2) the formation of particles increases. The particle filter can remove these additional particles very efficiently but the filter will have to be regenerated more often which leads to higher fuel consumption. At higher speed and load the engine out NOx emissions increase which means that the LNT has be regenerated more often. And at higher temperature the absorption doesn't work efficiently. An LNT can have a high conversion efficiency at the European driving cycle (NEDC), but the off-cycle emissions under normal driving conditions aren't reduced by a high rate.

37. The additional cost of a LNT system is estimated to 320 US$ (ICCT). The cost estimation is highly dependent on the price of Platinum and Rhodium as the system for 2 l engine contains about 10 to 12 g noble metal.

38. Another disadvantage is the "poisoning" by sulfur oxide. As the binding of sulfur oxide is higher than for NOx, a "desulfurisation" cycle is needed regularly. This increases the fuel consumption penalty.

39. In addition, the durability requirements and in use performance testing introduced in the EU regulation increase the cost for LNT because the catalyst is ageing if exposed to higher temperatures.

C. Applicable EU Regulations Concerning NOx Diesel Emissions, AECD <u>Disclosure and Defeat Devices</u>

40. As discussed above, *supra* at ¶ 20, the NOx emission standards under Euro 4, Euro 5 and Euro 6 are clearly defined.

41. The justification for EU emission regulations is set forth in paragraph 5 of (EC) 715/2007:

> "Achieving EU air quality objectives requires a continuing effort to reduce vehicle emissions. For that reason, industry should be provided with clear information on future emission limit values."

42. Paragraph 6 states:

> "In particular, a considerable reduction in nitrogen oxide emissions from diesel vehicles is necessary to improve air quality and comply with limit values for pollution. This requires reaching ambitious limit values at the Euro 6 stage without being obliged to forego the advantages of diesel engines in terms of fuel consumption and hydrocarbon and carbon monoxide emissions."

43. Paragraph 12 states:

> "Efforts should be continued to implement stricter emission limits, including reduction of carbon dioxide emissions, and to ensure that those limits relate to the actual performance of vehicles when in use."

44. These paragraphs make clear that the purpose of the regulations is not to lower the emissions in the laboratory, but rather to lower the emission in the ambient air during real world vehicle use.

45. A "defeat device" is defined in article 3, No. 10 of the regulation:

> "'defeat device' means any element of design which senses temperature, vehicle speed, engine speed (RPM), transmission gear, manifold vacuum or any other parameter for the purpose of activating, modulating, delaying or deactivating the

> operation of any part of the emission control system, that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and use;

Article 5 goes on to prohibit the use of defeat devices:

> "1. The manufacturer shall equip vehicles so that the components likely to affect emissions are designed, constructed and assembled so as to enable the vehicle, in normal use, to comply with this Regulation and its implementing measures. 2. The use of defeat devices that reduce the effectiveness of emission control systems shall be prohibited. The prohibition shall not apply where: (a) the need for the device is justified in terms of protecting the engine against damage or accident and for safe operation of the vehicle; (b) the device does not function beyond the requirements of engine starting, or (c) conditions are substantially included in the test procedures for verifying evaporative emissions and average tailpipe emissions."

46. **This means, any device which reduces or deactivates an emission control device under normal use is forbidden.**

47. The question is what "normal use" is. As the same language is used in the EU legislation for brakes and child seats, it is clear that normal use does not mean the function of the emission control can be limited to a temperature range or a speed range. Clearly it is also forbidden to deactivate or reduce the effectiveness of an emission control device after a distinct time of operation.

48. The second sentence of the above emissions regulation provides exceptions. Like all exceptions these are to be interpreted narrowly. An OEM (Original Equipment Manufacturer) that wants to use these exceptions must provide a justification with particularity. That is, the OEM must demonstrate that the shutdown device is "necessary". This is not the case if they are by design, or the construction material selection can be avoided.

49. With its application documents, the manufacturer has to prove that the engine system complies with the relevant EC requirements. It has to deliver complete and verifiable

documentation. In particular, information on electronic control includes emission control devices, including the measures against air pollution which have to be documented.

50. If a manufacturer wants to use an exception it has to declare it in the application and include the justification.

51. In addition to the EC regulation NO 715/2007, there is also EC No 692/2008, which describes in more detail the specific technical provisions necessary to implement Regulation EC 715/2007.

52. In article 3, No 9. the following requirements are laid out:

> "However, when applying for type-approval, manufacturers shall present to the approval authority with information showing that the NOx after treatment device reaches a sufficiently high temperature for efficient operation within 400 seconds after a cold start at – 7 °C as described in the Type 6 test.
>
> In addition, the manufacturer shall provide the approval authority with information on the operating strategy of the exhaust gas recirculation system (EGR), including its functioning at low temperatures.
>
> This information shall also include a description of any effects on emissions.
>
> The approval authority shall not grant type-approval if the information provided is insufficient to demonstrate that the after treatment device actually reaches a sufficiently high temperature for efficient operation within the designated period of time.
>
> At the request of the Commission, the approval authority shall provide information on the performance of NOx after treatment devices and EGR system at low temperatures."

53. This wording of the regulations shows that according to the implementing regulation the NOx after treatment devices even at the mentioned cold ambient temperatures have to work properly except in the first 400 seconds after a cold start and thus effectively reduce emissions.

54. Proof of compliance with the above mentioned rules is required by the OEM

55. **This wording shows also that the reduction of the EGR rate or closing the EGR valve isn't in line with the EU regulation, as the EGR is used to reduce the engine out NOx emissions.**

56. Manufacturers have argued that they have to reduce the EGR rate or even close the ERG valve at lower temperatures (the so called "thermo window" starts at 19 degree C (FIAT) and 10 degree C (Daimler, VW)) to avoid fouling of the EGR valve. But is worth noting that not all manufacturers claim this is necessary, demonstrating that there are other solutions that do not require reducing the EGR rate and increasing NOx emissions.

57. In addition, if alternatives are available, the argument of engine protection can't be used. In the case of EGR, it is possible to clean or to replace the EGR valve at normal maintenance intervals, if the manufacture thinks it is required.

58. The "International Council on Clean Transport", (ICCT) compared in a briefing the EU and US regulation about defeat devices (ICCT 2016).[1]

59. In spite of the fact that the US regulation (40 CFR §86.1803-01) defines auxiliary emission control device (AECD) separately, the wording used in the EU regulation (EC) No 715/2007 Art. 3, par.10, is nearly identical.

60. The U.S. regulation (40 CFR §86.1803-01) defines a defeat device as follows:

> "1 Defeat device means an auxiliary emission control device (AECD) that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and use, unless: (1) Such conditions are substantially included in the Federal emission test procedure; (2) The need for the AECD is justified in terms of protecting the vehicle against damage or accident; (3) The AECD does not go beyond the requirements of engine starting; or (4) The AECD applies only for emergency vehicles and the need is justified in terms of preventing the vehicle from losing speed, torque, or power due to abnormal conditions of the emission control

[1] https://www.theicct.org/publications/defeat-devices-under-us-and-eu-passenger-vehicle-emissions-testing-regulations

> system, or in terms of preventing such abnormal conditions from occurring, during operation related to emergency response. Examples of such abnormal conditions may include excessive exhaust backpressure from an overloaded particulate trap, and running out of diesel exhaust fluid for engines that rely on urea-based selective catalytic reduction."

It additionally defines an AECD (§86.1803-01) as:

> "any element of design which senses temperature, vehicle speed, engine RPM, transmission gear, manifold vacuum, or any other parameter for the purpose of activating, modulating, delaying, or deactivating the operation of any part of the emission control system."

And it prohibits (§86.1809-01) the use of defeat devices:

> "(a) No new light-duty vehicle, light-duty truck, or complete heavy-duty vehicle shall be equipped with a defeat device."

Code of Federal Regulations, Title 40 Part 86 – Control of Emissions from New and In-Use Highway Vehicles and Engines.[2]

61. Where the U.S. regulation defines a defeat device by reference to a separately defined AECD, the European Union regulation (Regulation (EC) No 715/2007 Art. 3, par. 10) combines the two into a single definition, using nearly identical language:

> "'defeat device' means any element of design which senses temperature, vehicle speed, engine speed (RPM), transmission gear, manifold vacuum or any other parameter for the purpose of activating, modulating, delaying or deactivating the operation of any part of the emission control system, that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and use"

D. <u>Analysis of Various FCA Vehicles Sold In Europe and Discussion of Their NOx Emissions, AECDs and Defeat Devices</u>

62. After the September17, 2015, when the VW Diesel scandal was made public, a number of European countries began emission testing of EU 5 and EU 6 Diesel vehicles. The testing included – in addition to the official emission testing following the procedure of the EU

[2] The text of the U.S. regulation is online at http://www.ecfr.gov/cgi-bin/text-idx?node=pt40.19.86 &rgn=div5#se40.19.86_11809_601.

emission regulation, the "NEDC" testing, at "cold start" (start between 20 and 30 degree C) – hot start, reverse cycle testing, extended NEDC testing (+10% speed), different start temperature and testing on the road with portable emission testing equipment (Portable emission measurement system, "PEMS"). On-the-road testing was performed with a NEDC, an extended NEDC+10% speed and so called real drive emission testing (RDE), where the cars are used under real driving conditions. These tests included cars and vans.

4. **The German Test Program**

63. In Germany 53 Diesel models were tested, including 5 vehicles with a powertrain from FCA. Four vehicles were certified according to EU 5, and one according to EU 6. All five vehicles show unusual emission behavior outside of the NEDC cold start procedure. The report was published in May 2016.[3]

64. The **Fiat Panda** is certified according to EU 5 and met the emission limit of 180 mg/km on the official cold start NEDC certification test. But even in the same test at the laboratory at hot start, the emissions were 2.7 times higher. When the same NEDC test was executed on the road with warm engine the emissions were 4.4 times higher. When the NEDC was driven with a slightly higher speed (+10%), the emissions were 5.6 times higher.

		Chassis dynamometer			Portable Emission Measurement System (PEMS)				
Manufacturer	Trade name	NEDC cold (mg/km)	NEDC hot/ PEMS validated (mg/km)	NEDC 10°C (mg/km)	NEDC road (mg/km)	NEDC back (mg/km)	NEDC +10% (mg/km)	NEDC -10% (mg/km)	RDE run (mg/km)
Fiat	Panda 1.3l	143.00	386.00	127.11	636.08	510.74	803.79	610.28	605.02

65. "NEDC cold" is the official EU certification test. "NEDChot" is the same driving cycle but started with a hot engine. "NEDC 10 degree C" is the same driving cycle but driven at 10 degree C ambient temperature instead of the 25 degree C (between 20- 30 degree) ambient

[3] https://www.bmvi.de/SharedDocs/EN/publications/bericht-untersuchungskommission-volkswagen.html

temperature. "NEDC road" is the same driving cycle driven on the road at ambient conditions, for the NEDC back the driving cycle is driven in the reverse order. "NEDC +10%" is the same driving cycle but with 10% higher speed and "NEDC -10%" is with 10% lower speed. "RDE" (Real Drive Emission Test) is driven on the roads in normal traffic conditions.

66. The other FCA EU 5 test vehicle was a **Fiat Ducato**, certified as light duty vehicle (LDV). The emission limit EU 5 for LDV was 280 mg/km NOx.

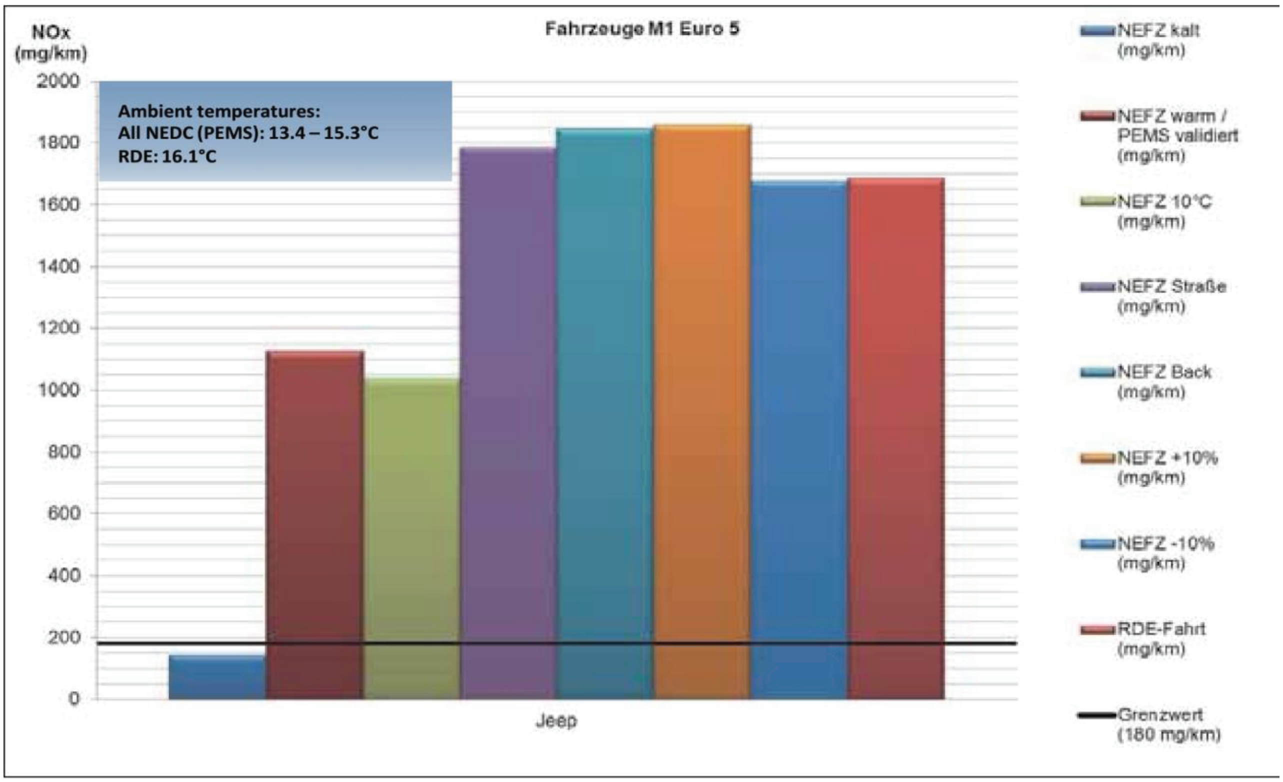
		Chassis dynamometer			Portable Emission Measurement System (PEMS)				
Manufacturer	Trade name	NEDC cold (mg/km)	NEDC hot/ PEMS validated (mg/km)	NEDC 10°C (mg/km)	NEDC road (mg/km)	NEDC back (mg/km)	NEDC +10% (mg/km)	NEDC -10% (mg/km)	RDE run (mg/km)
Fiat	Ducato 3.0l	236.00	1171.00	1042.00	1209.39	1190.20	1516.54	1209.39	2514.77

67. At the NEDC cold start procedure the vehicle met the emission limit. But on the road tests the emissions were up to 10.6 times higher than the EU 6 NOx emission limit.

68. The third EU 5 vehicle tested in the German program with a FCA power train was a **Jeep Cherokee 2.0 l Diesel** engine. This vehicle also met the EU 5 emission standard on the official cold start NEDC certification test. But on the road test the vehicle produced extremely high emissions. The only explanation for these wide variances is that the EGR is reduced by a large extent or switched off, because this model has only an EGR as NOx reduction device.

		Chassis dynamometer			Portable Emission Measurement System (PEMS)				
Manufacturer	Trade name	NEDC cold (mg/km)	NEDC hot/ PEMS validated (mg/km)	NEDC 10°C (mg/km)	NEDC road (mg/km)	NEDC back (mg/km)	NEDC +10% (mg/km)	NEDC -10% (mg/km)	RDE run (mg/km)
Jeep	Cherokee 2.0l	144.00	1127.00	1039.32	1784.49	1847.15	1859.87	1678.24	1687.32

69. The following graph shows the drastic impact of FCA's manipulation of the emission control system. As all NEDC tests require the same engine load, the engine temperature during the test also similar and therefore so is the NOx formation (if nothing else is changed). The only way to cause such high amounts of engine out NOx emissions is the reduction or



switch-off of the EGR.

The Jeep Cherokee EU 5 2.0 l.

70. The forth EU 5 vehicle was a Alfa **Romeo Giulietta, 2.0 l Diesel**. This vehicle also showed the same emission pattern.

		Chassis dynamometer			Portable Emission Measurement System (PEMS)				
Manufacturer	Trade name	NEDC cold (mg/km)	NEDC hot/ PEMS validated (mg/km)	NEDC 10°C (mg/km)	NEDC road (mg/km)	NEDC back (mg/km)	NEDC +10% (mg/km)	NEDC -10% (mg/km)	RDE run (mg/km)
Alfa Romeo	Giulietta 2.0l	130.96	430.77	525.21	1346.34	1254.99	1396.17	1254.41	905.37

71. Again the vehicle clearly met the EU 5 emission standard on the NEDC test, but at the road test under the same load conditions the emissions were much higher. Also the emissions at real drive emission tests were with 905 mg/km very high.

72. The fifth vehicle was a **Suzuki Vitara EU 6, 1,6 l FCA power train**.

73. The report by the German minister of transport states:

> "All in all, this implies a large dependence of the EGR. Although the manufacturer FCA (Suzuki uses a powertrain produced by FCA) explains that the EGR rate was reduced less on the basis of the ambient temperature compared to its Euro 5 engines, the EGR rate is still reduced by about two-thirds at a temperature of approximately 7 °C in order to prevent the possible generation of shocks due to humid soot deposits in the diesel particulate filter and the destruction of the LNT due to the concentration and burning of hydrocarbon accumulations, and to avoid misfires and permanent damage to the EGR components and the LNT/DOC."

74. This makes it clear that FCA has the responsibility for the Suzuki power train calibration.

75. Also in this case the vehicle met with 30 mg/km NOx the stricter EU 6 emission standard of 80 mg/km NOx on the official cold start certification test by a wide margin.

76. The road NOx emissions of the EU 6 Suzuki Vitara are on the same level as for the EU 5 Alfa Romeo Giulietta. (RDE test: Alfa Romeo 905 mg/km, Suzuki Vitara 1122 mg/km NOx). This means despite the reduction of NOx emissions permitted under EU regulations (from 180 mg/km (EU 5) to 80 mg/km NOx (EU 6)) FCA's vehicles continued to emit NOx at the same level in the real world. This shows that the calibrations on FCA's vehicles were adjusted to meet the new regulatory emissions during the test but operated the same in real-world driving conditions.

		Chassis dynamometer			Portable Emission Measurement System (PEMS)				
Manufacturer	Trade name	NEDC cold (mg/km)	NEDC hot/ PEMS validated (mg/km)	NEDC 10°C (mg/km)	NEDC road (mg/km)	NEDC back (mg/km)	NEDC +10% (mg/km)	NEDC -10% (mg/km)	RDE run (mg/km)
Suzuki	Vitara 1.6l	30.00	68.00	593.61	919.13	979.20	1173.00	967.87	1122.00

77. The factor of the emission cold start test in laboratory to the road NEDC test (which is the same driving cycle but only driven on the road) is an unbelievable 30.6 times. In this case not only is the EGR reduced dramatically, but also the NOx LNT after treatment is not working to a very large extent, as was admitted by FCA according to report of the German minister of Transport. (See above).

78. The same report also states:

> ***"This emission reduction strategy, which is largely dependent on the outside temperature, reduces the efficiency of the emission control system under conditions which are to be expected in normal vehicle operation and use."***

79. Based on the above, it is clear that the vehicles discussed violated EU 5 and EU6 emissions regulations because the vehicles NOx emissions are too high and because the emissions controls are not allowed to reduce the effectiveness of the emission abatement systems in dependence of the temperature and the time of the test. Such a system is clearly a defeat device.

80. Indeed, as part of the KBA's investigation into FCA and as a result of the above tests the KBA discovered that the vehicles contained at least one defeat device that shut off the vehicles' EGR after about 22 minutes. The certification test lasts 20 minutes. http://www.spiegel.de/auto/aktuell/abgaswerte-kraftfahrt-bundesamt-geht-offenbar-gegen-fiat-vor-a-1093484.html

81. Moreover, given the drastic difference in NOx emissions between the cold start certification test and the same test with a warm start, it is clear that the vehicles also contained an

defeat device that reduces the effectiveness of the emission controls when it detects that the vehicle is not running on a certification test.

82. On November 19, 2015 FCA met with the KBA ("Kraftfahrt Bundesamt", the German Federal Motor Transport Authority) concerning its investigation into FCA's European vehicles and the results of KBA's NOx emissions field tests of the Fiat Ducato, Jeep Cherokee and Alfa Romeo Giulietta (certified to Euro 5 standards). FCA-PIRNIK-001633470.

83. On November 27, 2015, FCA sent a letter to the KBA in response to questions the KBA had concerning the emissions controls on the Jeep Cherokee, Alfa Romeo Giulietta, Fiat Panda and Fiat Ducato. These questions resulted from NOx emissions tests that had been carried out by the KBA. FCA-PIRNIK-001633444. KBA emailed FCA Germany AG on December 30, 2015, requesting details of the aftertreatment systems of the vehicles the KBA had tested -- the Jeep Cherokee, Alfa Romeo Giulietta, Fiat Panda and Fiat Ducato. *Id*. The tests conducted by the KBA showed that FCA's vehicles emitted high levels of NOx and were non-compliant with European regulations, and the KBA requested a statement from FCA of its views regarding the results of the tests that the KBA carried out. *Id*. at 445.

84. As discussed above, the KBA had found evidence that the exhaust treatment system in some of FCA's vehicles would switch itself off after 22 minutes, which is just 2 minutes after the standard 20 minute emissions test normally run by regulators. This was similar to the scheme conducted by Volkswagen where its defeat devices turned themselves off after 23 minutes to cheat the emissions tests. The German tests found a special NOx catalyst which was being switched off after a few cleaning cycles. This shut down caused NOx to be released into the atmosphere at more than 10 times the permitted level. The KBA had determined that FCA had used illegal software to manipulate emissions controls.

85. On December 10, 2015, Steve Mazure emailed Vaughn Burns and Mike Dahl stating "Sergio [Marchionne] is apparently getting daily updates on this diesel defeat investigation in Germany and Korea from EMEA PT task Force." FCA-PIRNIK-002074700. FCA had suspended sales of the diesel vehicle in Korea as FCA's EMEA Office of General Counsel because Korean regulators had requested details "on NSC and EGR deactivation" in FCA's vehicles because FCA was "concerned that details will affect Germany investigation." *Id*. ("NSC" refers to "NOx storage converter" technology implemented on certain European FCA vehicles, but not used in the United States).

86. On January 13, 2016 Aldo Marangoni, FCA's EMEA Region – Head of Powertrain Engineering, sent an email to Bob Lee attaching the final version of FCA's Response to the KBA, which Marangoni and Lee had previously discussed on a telephone call. FCA-PIRNIK-001633433; FCA-PIRNIK-001633444. In the letter, FCA provided the information requested by the KBA and argued that FCA's vehicles complied with all regulatory requirements despite the KBA's test results. *Id*. at 445. The letter was sent to the KBA on January 15, 2016. FCA-PIRNIK-001633470.

87. Mr. Marchionne testified that by January 2016 "we had the KBA, which is the regulator in Germany, decide to carry out studies of all the other competing brands. They were starting to make statements. It looked like the Germans were going to throw everyone under the bus…" *Id*. at 148:15-20. "The real thorny issue was Europe because at that time the noise out of Europe was incessant. Our people had interfaces with the regulators in Germany at the time." *Id*. at 1502-6. "<u>**The Germans really became to be a pain in the butt. It was really ugly stuff**</u>." *Id*. at 150:19-20 (emphasis supplied). Mr. Marchionne testified that the interaction with the Germans was elevated to the highest levels. *Id*. at 150:22-25. "The people involved on the other side was

the Minister of Transport in Germany." *Id*. 151:2-3. Mr. Marchionne testified "I mean, if I told you everything else that went on in Europe in terms of the interface with the KBA, we would be here for days. There were pretty ugly meetings going on between counsel and the KBA. Ugly." *Id*. 152:2-6. "**We were being accused of cheating** … I mean, it turned into an incredible nightmare. And Bosch, who has been our supplier for a long period of time, forever, took a very distant position from all their involvement in diesel and … I think they disclosed the whole pile of stuff to the German authorities to gain their sort of … get a pass." *Id*. at 159:15-160:9 (emphasis supplied). "Over there was one regulator in Germany who had decided, in our view with the help of Bosch, who decided to get a free pass. They were disclosing information, saying these guys are in violation. This is the issue of the T_eng stuff. There may have been other conditions that were built into the logic of the Bosch software that was made available by Bosch to us as a customer that was being used as a potential pretext to say you're screwing around with the rules." *Id*. at 162:21-163:6. *See also id*. at 164:6-16. Mr. Marchionne testified, "I had a meeting with Merkel and Ramsey at the time." *Id*. at 165:3-4. "[T]he urgency of the European matter was such that I had to deal with, I could not ignore Dobrindt." *Id*. at 165:21-23.

88. FCA had additional meetings with the KBA on February 18 and Mach 2, 2016, and sent letters to KBA on February 29 and March 16, 2016. FCA-PIRNIK-001633470. During these meetings, the KBA told FCA that they believed that FCA's vehicles emitted illegal levels of NOx and contained defeat devices. *Id*.

89. On March 21, 2016, Bob Lee and Aldo Marangoni had a call to discuss FCA's letter response to the KBA. FCA-PIRNIK-001633468. Following the call, Mr. Marangoni sent a draft letter to Mr. Lee. Mr. Lee edited the letter and sent it back to Mr. Marangoni stating "As I mentioned on the phone this morning, I think the document is OK as written. However, for

English language readability I made a few suggestions which should not be considered binding." *Id*. The letter to KBA addressed the possibility that the KBA would publish the results of its emissions tests of FCA's vehicles and KBA's conclusions regarding the non-compliance of FCA's vehicles and the existence of defeat devices on FCA's vehicles. FCA-PIRNIK-001633470.

90. The German minister for Transport called the Fiat officials to meeting into the ministry to discuss the very high emissions. The Fiat officials refused to meet the minister.[4]

Federal Minister Alexander Dobrindt:

> *„It is completely incomprehensible why Fiat is showing such uncooperative behaviour. We are dealing with precise allegations. It would be appropriate for Fiat to meet with the commission of inquiry to comment on them."*

91. On May 23, 2016, it was reported that the KBA had found evidence that the exhaust treatment system in some of FCA's vehicles would switch itself off after 22 minutes, which is just 2 minutes after the standard 20 minute emissions test. The report revealed that the German tests found a special NOx catalyst which is being switched off after a few cleaning cycles. This shut down caused NOx to be released into the atmosphere at more than 10 times the permitted level. A German newspaper, the Bild am Sonntag reported that Germany's Federal Motor Transportation Authority determined that Chrysler allegedly used illegal software to manipulate emissions controls.

92. My conclusions are further supported by the fact that Bosch has confessed to the German ministry that FCA used these defeat devices. One defeat device was a time counter that changed the engine calibration after 1180 seconds (which is the length of emission testing in the

[4] http://www.bmvi.de/SharedDocs/EN/PressRelease/2016/071-dobrindt-fiat.html

NEDC procedure) after the cold start in the laboratory, which resulted in to a large increase in NOx emissions.

93. On December 3, 2015, Allievi Gabriele – President of Robert Bosch GmbH Branch in Italy – emailed Alfredo Altavilla, Aldo Marangoni and Bob Lee of FCA requesting a meeting concerning the emissions controls in FCA's vehicles:

> "We are currently conducting an internal investigation with a view to the VW emission matter. During our investigation we became aware of information relating to various engines of Fiat Chrysler Automobiles and their respective emission control systems. We kindly ask your availability to meet in Turin, possibly on December 21st or 22nd to discuss this information."

FCA-PIRNIK-001624166 (emphasis original).

94. On January 20, 2016, Bob Lee, Alfredo Altavilla and Aldo Marangoni met with Bosch in FCA's offices in Turin (Bob Lee participated by video conference). Lee Tr. at 158:15-16; FCA-PIRNIK-001625921. At the meeting Bosch raised questions whether several functions in certain of FCA's diesel vehicles "comply with emission laws and regulation." *Id*. Bosch told FCA that they believed the following vehicles had functions that did not comply with emissions laws and regulations: Jeep Grand Cherokee 3.0L, Ram 1500 3.0L, and Ram Promaster 3.0L sold in the U.S. as well as "Fam. B 1.6l NSC, 2.0l NSC, 2.2l NSC, B428 2.8l NSC" (the "Fam. B Vehicles") and "Maserati Ghibli 3.0l V6 EU6 SCR EU6; Maserati Quattroporte 3.0l V6 EU6 SCR EU6" (the "Maserati Vehicles"). *Id*. Specifically, regarding the the European Fam. B Vehicles, Bosch's concerns were as follows:

1. AdBlue dosing strategy: AdBlue dosing reduction after first acceleration outside NEDC via AdBlue Online Dosing function "pre-control mode 2"
2. AdBlue dosing strategy: AdBlue dosing reduction in vehicle "Sport Mode" via AdBlue Online Dosing function "pre-control mode 2"

Id. at 924.

95. At the meeting, FCA committed to provide written confirmation of the compliance of each of the vehicles that addressed Bosch's specific concerns. *Id*. Bosch followed up on the request on January 29, February 9 and February 12, 2016 but still had not received the promised documentation. *Id*.

96. Sergio Marchionne (CEO of FCA) testified that he was aware in December 2015 that Bosch had done their own internal investigation and had information regarding the emission control systems of vehicles FCA was selling in Europe. Marchionne Tr. at 93:22-94:2. He was aware of the audit results of Bosch in January 2016. *Id*. at 144:8-19. He testified that he was provided an update by either Bob Lee or Alfredo Altavilla on the meeting they had with Bosch concerning what was found regarding Bosch's internal investigation. *Id.* at 95:10-17.

97. On February 19, 2016, FCA had another teleconference with Bosch. Following that conference, Markus Heyn of Bosch emailed Alfredo Altavilla, Bob Lee and Aldo Marangoni: "thank you for having the short telco today. As indicated I have provided a letter to you and to Bob Lee which specifies the documentation we need from FCA. As you have proposed early next week the documentation should be agreed and sent to us asap. Since Bob Lee and Aldo Marangoni have been participating in our meeting in January, I have copied them in the email. Looking forward to seeing you in Geneva." FCA-PIRNIK-001625920. The attached letter recounted the past communications between FCA and Bosch and included as "Annex I" a description of the written documentation that Bosch had previously requested that FCA never provided. FCA-PIRNIK-001625921. The letter concluded: "As previously discussed, if Bosch does not receive satisfactory documentation, unfortunately we will be compelled to stop deliveries of the relevant engine controls. Please provide the documentation no later than 25 March 2016." *Id*.

98. On March 29, 2016, Aldo Marangoni wrote a letter to executives at Bosch, Markus Heyn, Camillo Mazza, Martin Reuter and Lothar Schmidt (cc'ing Bob Lee, Alfredo Altavilla and Giorgio Fassati of FCA), defending the features identified by Bosch, stating that they were all necessary for the protection of the engine. FCA-PIRNIK-001633462.

99. On April 11, 2016, Giorgio Fossati emailed Bob Lee, cc'ing Aldo Marangoni, Bosch's response to FCA's letter of March 29, 2016. FCA-PIRNIK-001633435. In that letter, Bosch informed FCA, among other things, that as part of the KBA's ongoing investigation into Bosch and FCA, Bosch would disclose the problematic features on the Fam. B. Vehicles. FCA-PIRNIK-001633436, at 438.

100. The German government commenced an official complaint to the EU commission and on August 31, 2016 wrote to the Italian transport ministry and the EU commission DG Growth. In these letters the German transport ministry stated:

> "Due to indications of irregularities in the emission control system in EU 6 vehicles with diesel engines (displacement 1.6l, 2.0l and 2.2, l) of the manufacturer Fiat-Chrysler in the context of the emission tests of the commission VW, the KBA has performed own investigations on a further four FCA vehicles.. The results of these studies clearly show that qualitatively similar behavior in the increase of NOX emissions from cycle to cycle is present in all vehicles tested. With the shutdown of the regeneration of the NOX storage catalytic converter (LNT) after 6 regeneration cycles, the NOX values rise sharply to 9 to 15 times the emission limit value. This includes switching off exhaust gas recirculation (EGR) after 22 minutes and shut off the regeneration of the LNT after approx. 6 regeneration cycles. Thus, from our point of view, proof of the use of an inadmissible defeat device has been provided."

101. The EU started a mediation process between Germany and Italy. On March 14th 2017 the EU commission announced that Italy and Germany found a common understanding and a service campaign will be launched by FCA on the Fiat 500 X 2.0 l Diesel. No further information was released.

https://www.telegraph.co.uk/cars/news/diesel-emissions-scandal-fiat-under-investigation/

5. <u>The French Test Program</u>

102. My conclusions are further supported by testing performed by the French ministry of Environment, which conducted similar vehicle testing. The French ministry of Environment's report was published end of July 2016 and 86 vehicles were tested. The report is available under title: **"Rapport final de la commission indépendante mise en place par la Ministre Ségolène Royal après la révélation de l'affaire Volkswagen".**

103. Five FCA vehicles were tested, three EU 5 and two EU 6: **<u>The Fiat Doblo, Fiat 500X, Fiat 500L, Alfa Romeo Giulietta, and Jeep Cherokee</u>**. In the French testing conducted only the official certification test, NEDC cold, followed by a hot NEDC test. In addition, the NEDC was performed on the road, using PEMS devices.

Marque	Modèle	Reg	Cylindrée	Puissance (cv)	Systèmes dépoll	Kilométrage [km]	NOx mesuré en homol [mg/km]	CO2 Déclaré [g/km]	NOx - D1 [mg/km]	EUDC D1 [mg/km]	EUDC - D2 [mg/km]	NOx D3	Tamb -min [°C]	T amb -max [°C]	D1 [g CO2/km]	D3 [gCO2/km]
Fiat	Doblo	Euro5 N1C2	1.3L	90	EGR	4695	206	115	**176,4**	**172,5**	**368,79**	**1003**	8,0	8,0	**145,65**	**161,6**
Fiat	500X	Euro6	2L	140	EGR + NoxTrap	11700	68,2	144	**246,7**	**287**	**528,5**	**1354**	5,0	9,0	**200,2**	**208**
Fiat	500L	Euro5	1.3L	85	EGR	15599	171,9	110	**224,5**	**216,2**	**387,5**	**337,6**	13,0	15,0	**137,9**	**135,6**
Alfa Romeo	Giulietta	Euro6	2L	175	EGR	8179	34,4	113	**169**	**144,3**	**190,9**	**766,2**	9,0	10,5	**138,4**	**144,1**
Jeep	Cherokee	Euro5	2L	170	EGR	20291	167,8	154	**183,8**	**126,2**	**1392,4**	**951**	7,0	8,0	**205,3**	**196,8**

<u>Explanations</u>:
NOx measure en homol: Test value of the official certification homologation test
NOx D1: Value measured in the certification cold start NEDC test with small variations.
NOx D2: Value measured in the warm NEDC test in the laboratory.
NOx D3: Value measured in the NEDC on the road.

104. Again, as shown in the above chart and completely consistent with the findings of the German regulators, the vehicles from FCA have very high emission levels in the tests at the road. This means under normal use, the emissions are much higher than under laboratory conditions.

105. The Fiat 500X and the Jeep Cherokee show especially high NOx emissions when the NEDC is driven on the road (1354 mg/km for Fiat 500X and 951 mg/km for Jeep Cherokee).

Moreover, the warm test for these two vehicle also exhibited very high NOx emissions (528.5 mg/km for Fiat 500X and 1392.4 mg/km for Jeep Cherokee).

106. French Investigators referred FCA for possible prosecution over abnormal nitrogen oxide pollutants from some of its Diesel engines.[5]

107. The Paris prosecutor had opened the investigation on 15 March 2017, after the French ministry's consumer affairs and anti- fraud body had referred the case to the courts.[6] The case is still ongoing and no further details are publicly available.

6. <u>The Dutch Test Program</u>

108. My conclusions are further supported by testing performed by RDW (Netherlands Vehicle Authority), which tested 30 Diesel vehicles. RDW detected unexplainable emission deviations in sixteen vehicles from seven manufacturers. During the tests at the RDW Test Centre, (significantly) increased NOx emissions were measured at particular speeds, times, distances or external temperatures.

109. A follow up investigation was started to check these vehicles more in detail. The results of these tests were published in 2017.[7]

110. Five vehicles were equipped with FCA engines.

- **<u>Suzuki Vitara</u>** Euro 6 Suzuki Motor Corporation Japan / motor FCA
- **<u>Suzuki SX4</u>** Euro 5 Suzuki Motor Corporation Japan / motor FCA
- **<u>Jeep Grand Cherokee</u>** Euro 5 Fiat Chrysler Automobiles (FCA)
- **<u>Jeep Wrangler Unlimited Van</u>** Euro 5 Fiat Chrysler Automobiles (FCA)
- **<u>Jeep Wrangler Unlimited Van</u>** Euro 5 Fiat Chrysler Automobiles (FCA)

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[5]https://www.forbes.com/sites/bertelschmitt/2017/02/07/fca-referred-to-french-prosecutor-on-dieselgate-charges/#12434d4c3dce

[6] https://www.bbc.com/news/business-39343412

[7]https://www.rdw.nl/-/media/rdw/rdw/pdf/sitecollectiondocuments/over-rdw/rapporten/rdw-emission-test-programme-english.pdf

111. The test program included the same emission tests as the German program, but included one additional test, the NEDC hot+load, where the normal certification NEDC test was driven, but with a higher load.

112. The **Suzuki SX4**, EU 5 showed high emission levels in the road tests ("CF" in the chart below means the factor between the NOx emission limits and the test result):

Test type	**Field tests Suzuki SX4**		**Laboratory test Suzuki SX4**	
	No_x measured	CF	No_x measured	CF
1 NEDC cold (T ambient ≥ 25)	457	2,5	190	1,1
2 NEDC hot	722	4	466	2,6
3 NEDC hot + load	693	3,9		
4 NEDC hot + 10%	691	3,8		
5 NEDC hot -10%	614	3,4		
6 NEDC hot back	453	3,6		
7 RDE	715	4,0		
8 NEDC cold (T ambient <20)	1059	5,9	221	1,2
9 NEDC hot (T ambient <20)	785	4,4	409	2,3
10 NEDC hot + 10%	820	4,6		
11 NEDC hot back	808	4,5		
12 NEDC hot - no start	757	4,2	487	2,7
13 RDE	739	4,1		

Based on the tests that were conducted at the RDW Test Centre, the following non-standard emission behaviour was detected:

Deviation in emission behaviour	**Yes**	**No**
Use of cold start recognition	X	
Use of a temperature window	X	
Use of a speed window (engine load)		X
Use of a distance window		X
Use of a time window		X

113. Moreover, as indicated in the above chart, the regulators also discovered cycle detecting defeat devices on the Suzuki SX4, EU5. The detection of a cold start in the laboratory can be done by detecting that the vehicle is stored at constant temperature of 25 degree C or by

the recognition of the preconditioning of the vehicle by driving three times the extra urban part of NEDC on the day before the emission testing. If such cold detection changes the emission level it is considered as a defeat device.

114. The regulators also discovered cycle detecting defeat device based on a “temperature window”. The temperature during the certification test is required to be between 20 and 30 degrees C. It is standard practice for 25 degrees C to be used. In addition, the vehicle is stored for between 6 and 12 hours before the test at a constant temperature of 20 to 30 degrees C (again, almost always at 25 degrees C). These temperatures can be used to detect the certification test.

115. The **Suzuki Vitara** EU 6 showed also a very strange emission behavior.

Test type	Field tests Suzuki Vitara No_x measured	CF	Laboratory test Suzuki Vitara No_x measured	CF
1 NEDC cold (T ambient ≥ 25)	145	1,8	90	1,1
2 NEDC hot	181	2,3		
3 NEDC hot + load	192	2,4		
4 NEDC hot + 10%	204	2,6		
5 NEDC hot -10%	180	2,3		
6 NEDC hot back	149	1,9		
7 RDE	n/a	n/a		
8 NEDC cold (T ambient <20)	290	3,6	377	4,7
9 NEDC hot (T ambient <20)	213	2,7		
10 NEDC hot + 10%	195	2,4		
11 NEDC hot back	148	1,9		
12 NEDC hot - no start	361	4,5	274	3,4
13 RDE	517	6,5		

Based on the tests that were conducted at the RDW Test Centre, the following non-standard emission behaviour was detected:

Deviation in emission behaviour	Yes	No
Use of cold start recognition		X
Use of a temperature window	X	
Use of a speed window (engine load)		X
Use of a distance window	X	
Use of a time window	X	

116. The detection of the certification test temperature and the test length are defeat devices and therefore illegal. The data show that at starts below 20 degree C the NOx emissions were increased. If the test was repeated without switching off the engine the emissions at real driving conditions the NOx emissions were also increased which indicate a distance window, which is a defeat device.

117. The RDW declared that this vehicle include illegal software and asked the Public Prosecution Service to take over the case. See also the press articles like euobserver from the 10th of July 2017.[8]

118. In addition these vehicles showed also a strong temperature depended emission behavior.

119. When the vehicle was tested on the road in the NEDC the emissions went up strongly. The emission values were more than 10 times above the emission limits.

Test type	**Field tests Suzuki Vitara**		**Laboratory test Suzuki Vitara**	
	No_x measured	CF	No_x measured	CF
1 NEDC cold (T ambient ≥ 25)	824	10,3	38	0,5
2 NEDC hot	601	7,5		
3 NEDC hot + load	537	6,7		
4 NEDC hot + 10%	681	8,5		
5 NEDC hot -10%	554	6,9		
6 NEDC hot back	601	7,5		
7 RDE	n/a	n/a		
8 NEDC cold (T ambient <20)	484	6,1		
9 NEDC hot (T ambient <20)	370	4,6		
10 NEDC hot + 10%	509	6,4		
11 NEDC hot back	560	7,0		
12 NEDC hot - no start	657	8,2	92 / 98	1,2 / 1,2
13 RDE	831	10,4		

120. The Jeep Grand Cherokee likewise demonstrated extremely high NOx emissions:

[8] https://euobserver.com/dieselgate/138471

Test type	Field tests Grand Cherokee		Laboratory test Grand Cherokee	
	No_x measured	CF	No_x measured	CF
1 NEDC cold (T ambient ≥ 25)	1249	6,9	220	1,2
2 NEDC hot	1874	10,4	1630	9,1
3 NEDC hot + load	2083	11,6		
4 NEDC hot + 10%	2062	11,5	1646	9,1
5 NEDC hot -10%	1972	11		
6 NEDC hot back	1914	10,6		
7 RDE	1889	10,5		
8 NEDC cold (T ambient <20)	1283	7,1		
9 NEDC hot (T ambient <20)	1935	10,8		
10 NEDC hot + 10%	2195	12,2		
11 NEDC hot back	1953	10,9		
12 NEDC hot - no start	2062	11,5		
13 RDE	1672	9,3		

Based on the tests that were conducted at the RDW Test Centre and in the laboratory, the following non-standard emission behaviour was detected:

Deviation in emission behaviour	Yes	No
Use of cold start recognition	X	
Use of a temperature window		X
Use of a speed window (engine load)	X	
Use of a distance window		X
Use of a time window		X

121. During the road tests, the Jeep Grand Cherokee exhibited high NOx values across the board. The vehicle showed much higher NOx emissions on the NEDC cold test at the road and in all hot tests. Also the real drive NOx emissions are much higher than the NOx emissions in the laboratory NEDC cold start test.

122. Similarly, RDW discovered a cycle detecting "cold start recognition" defeat device as well as a cycle detecting "speed window (engine load) defeat device, which means, the vehicle can detect that it is on the NEDC test based on the its speed. It is quite simple because the NEDC test cycle consists of defined speed versus time patterns. Both of these features are defeat devices and, therefore, illegal.

123. The Public Prosecution Service (OM) (the Dutch nationwide organization with offices at district and appeals courts) has been informed about this case.

124. Also, the Jeep Wrangler Unlimited Van Euro 5 (two cars) showed very high emission levels and unusual emission behavior (see table above).

7. Testing By Non-Government Organizations

125. Independent testing by Non-Government Organizations, including testing done by myself and my team, further support my conclusions.

i. My Testing of FCA Vehicles – Testing of the German NGO "Deutsche Umwelthilfe" (DUH)

126. Nearly my whole career in the German Environmental Agency, UBA, I was involved in emission testing and was aware of emission cheating including the use of defeat devices. Since the beginning of the Diesel scandal, the German NGO DUH has performed emission test in laboratories as well as PEMS (portable emissions measurement system) measurement of the emission behavior of vehicles on the road. More than 110 vehicles were tested on the road, the majority was Diesel vehicles. The vehicle I selected cover the diesel vehicles sold in Germany.

127. Among the vehicles I tested were therefore also 5 FCA vehicles. All models were EU 6 vehicles and sold from 2015 until today. The first Fiat vehicle tested was a **Fiat 500X 2.0 l**

4x4 EU 6 MJ 2015 at the official Swizz certification laboratory in Biel by the staff of the laboratory under my supervision. The following tests were performed:

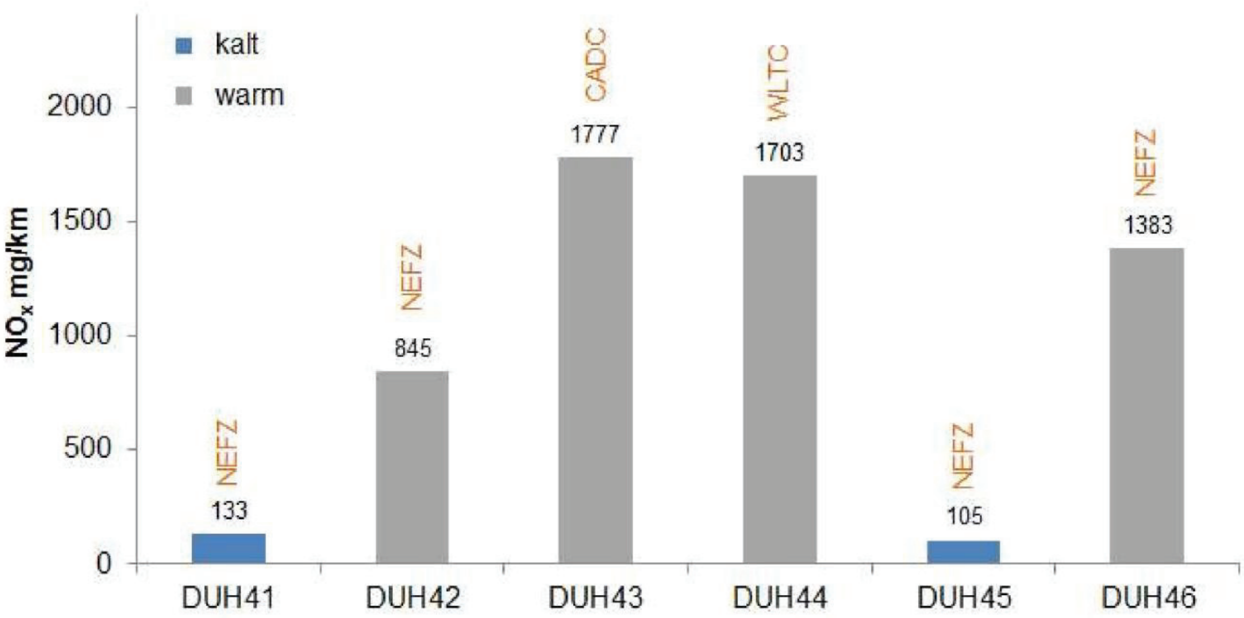
1. The official EU certification test, a cold start NEDC at 25 degree C (labeled as "kalt" in the graph below)

2. The same NEDC test was repeated with hot engine (labeled as "warm" in the graph below).

3. The CADC test. The CADC represents the driving on the road and is used in Europe to develop emission factors. (Emission factors are used for models to calculate the emissions in real live)

4. The WLTP (World Harmonized Test Procedure) test. The WLTP is the new European test procedure. From September 2018 new vehicles have be tested according to this new procedure. The WLTP is much more realistic than the NEDC procedure.

128. The graph below shows the results of the 6 different tests on the Fiat 500X. DUH41 and DUH45 are NEDC cold start test (the official certification test in Europe), DUH42 and DUH46 NEDC hot start tests, the DUH43 the CACD cycle and the DUH44 the WLTC (the future European test cycle).



129. The vehicle showed in the official certification cold start test an average emission of 118 mg/km NOx. The hot NEDC test was performed after the official certification cold start NEDC. The NOx emissions in the hot start were 1114 mg/km, which is nearly 10 times higher than in the NEDC cold start). As the engine load in the warm start test is the same as in the cold start test, similar NOx emissions are normally expected. As the engine is warm, even a slightly lower NOx emission is physically logical, because the warm engine oil generates lower friction and the catalyst is warmed up.

130. If such a high factor is detected between a cold start NOx emission test and a hot start emission test, it is a clear indication that the cold start certification test is detected. The cold start detection is a defeat device if the electronic control unit (ECU) changes the engine map settings to a higher NOx engine map.

131. When a WLTC test (warm start) was made, the NOx emissions were even higher, 1703 mg/km. In the so called CADC test cycle, which is used to develop emission factors and to reflect real driving on the road, more than 1777 mg/km were measured. Within this test the concentration of NOx even exceeded the maximum level of NOx that the lab analyzer could detect. The measurement instruments are designed to measure the highest NOx concentrations which the manufacturer of the equipment expects from the vehicles.[9]

132. The only explanation for this emission behavior in the different laboratory test is that the vehicle detects the cold certification NEDC test. Under European law (as in the US), this is a defeat device and cannot be used because the emission abatement technology is reduced or switched off outside of the official certification test ((EC) 715/2007). There is no other explanation for this emission behavior of the FIAT 500x.

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[9] https://www.duh.de/fileadmin/media/news_import/B449_DUH_FIAT_500X_unofficial_translation_EN_01.pdf

133. As discussed above, the test results from government certification agencies and from other test organizations support and confirm my findings and conclusions.

134. The results were published at the 9th of February 2016 and also sent to the German certification agency KBA as well to FCA Germany on the same day.

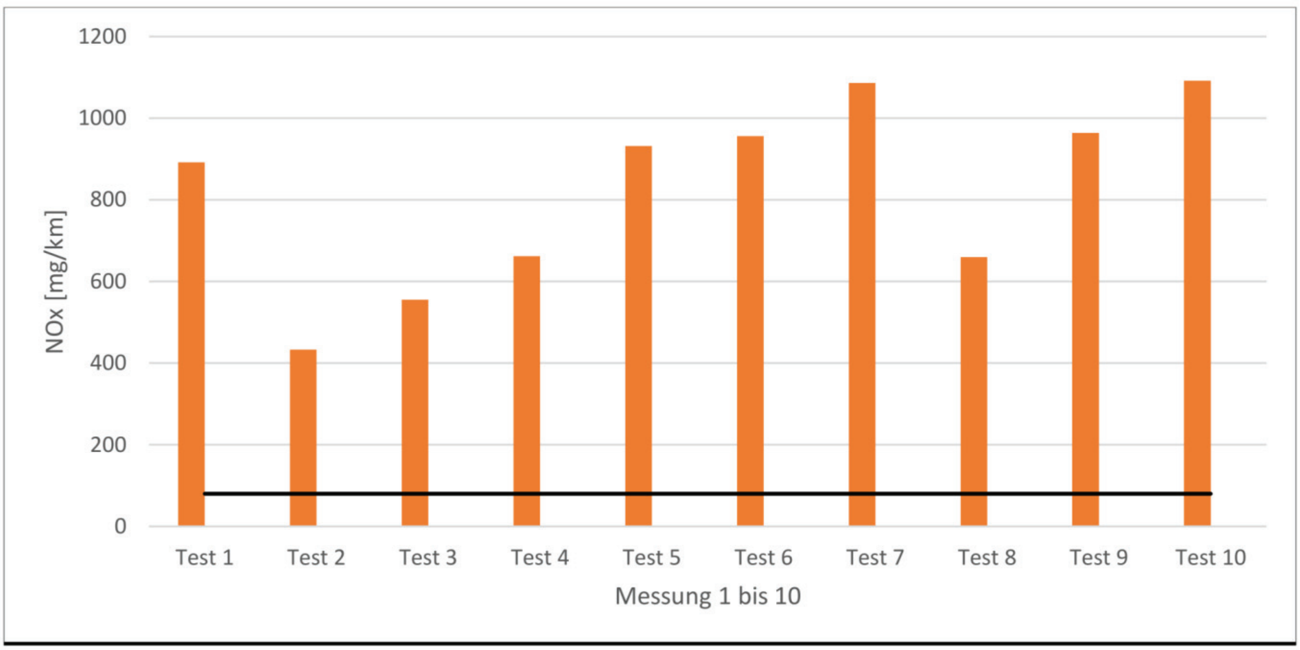
135. The same vehicle model, Fiat 500X, MJ 2016, were tested by Emissions-Kontrol-Institut (EKI) of the DUH on the road with a PEMS in 2016. The EKI was conducted under my supervision and the NOx emission were at the same level. The vehicle also showed on the road very high emissions of NOx. The emissions were 1380 mg/km as the average of ten RDE tests. This means 17.2 times above the EU 6 NOx emission limit of 80 mg/km. These results were made public on the 23rd of November 2016 and also delivered at the same day to the relevant authorities.[10]

136. After the discussion between the German and Italian government under mediation of the EU commission (see above) the Fiat 500X received a software update from FCA. A vehicle with the newest software update was tested in Spring 2017. The emission tests were done on the road with a PEMS.

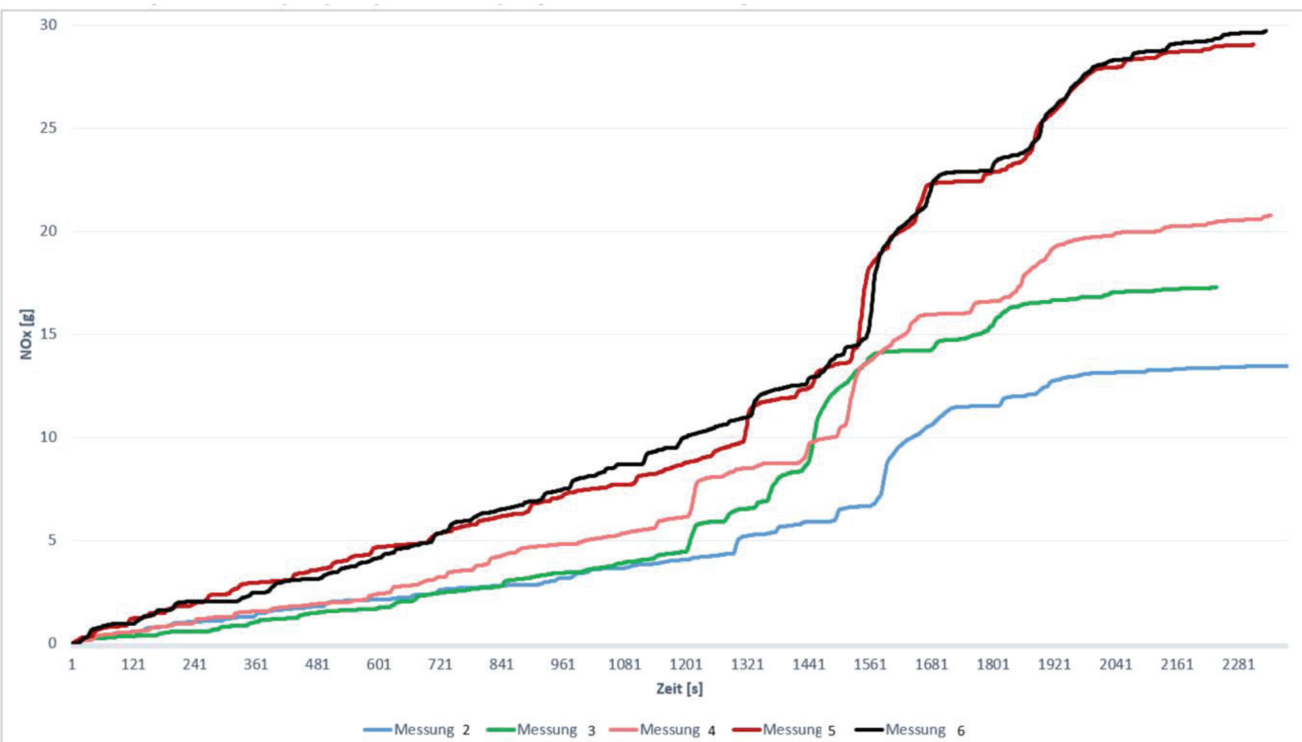
137. The second test showed, compared to the previous test, an improvement, but still at high level.

138. But if the same on-road emission test is repeated five times without switching off the engine between the tests, the NOx emission is after three test (each test is about 31 km long) at the same NOx emission level as before the update. This implies that the timer of the vehicle, which changes the settings of the ECU to a NOx Engine map with higher NOx emissions, is only activated after a longer driving period than before the update. It is still a defeat device.

[10]https://www.duh.de/fileadmin/user_upload/download/Projektinformation/Verkehr/dieselgate/Fiat_500X_Abgastest/Messbericht_Fiat_500X_2.0.pdf



139. The next graph shows the behavior over the duration of each trip. It shows the cumulative NOx emissions of each test. It can be seen from the graph, at which time the software changes the engine map.



140. In addition three FCA vehicles with a 1.6 l engine were tested by us, a **<u>Fiat 500x 1.6 l MJ 2ß16</u>** and two **<u>Jeep Renegades, 1,6 l, both MJ 2016</u>**. The NOx emission levels of these three vehicles are between 420 and 504 mg/km, which is between 5.3 and 6.3 times higher than

the emission standard, in violation of the EU emission regulations. The details specifics for each vehicle are in Exhibit 5.

ii. <u>The Real Urban Emissions (TRUE) Initiative</u>

141. The Real Urban Emissions (TRUE) Initiative has evaluated a large number of Remote Sensing Emission Testing data (RSD) to estimate the real world emission of vehicles. In June 2018 an analysis was published with new detailed data. This evaluation made it possible to calculate the average NOx emissions of different OEM's vehicles on the road.[11]

[11] https://www.theicct.org/publications/true-real-world-pv-emissions-rating-system

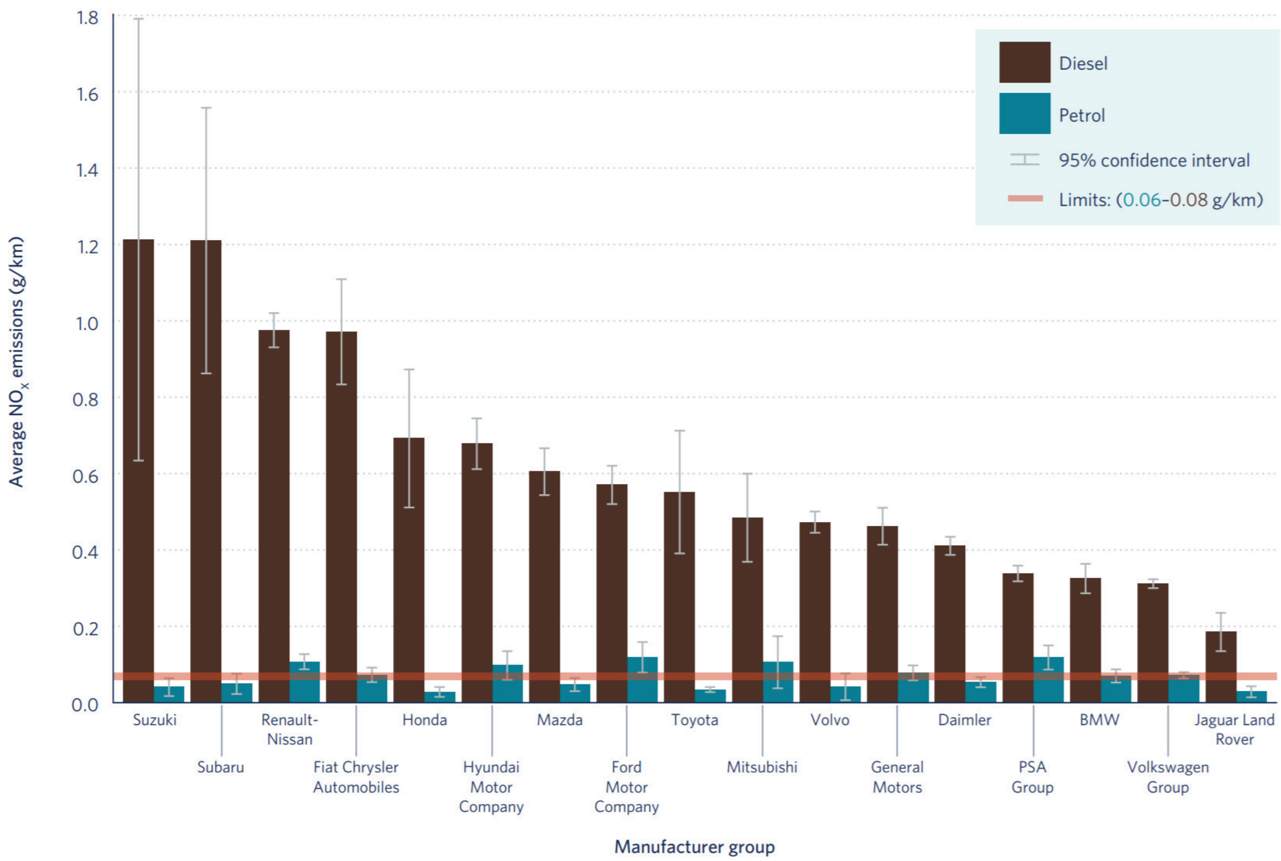


Figure 11: Overview of NO_x emissions (g/km) of the Euro 6 fleet per manufacturer group, for petrol and diesel passenger vehicles.

Manufacturer Group	Fuel type	Engine size (l)	# PEMS tests by Member states (and others)	# RSD records	Average NO_x —PEMS (g/km)	Average NO_x —RSD (g/km)	Average/ min/max ambient temperature —PEMS (°C)	Average/ min/max ambient temperature —RSD (°C)
Fiat Chrysler Automobiles	Diesel	2	2	52	1.06	1.49	8.4 / 5.0/10.5	21.8/ 12.3/32.5
Hyundai Motor Company	Diesel	2.2	12	80	0.31	1.3	23.1/ 20.9/25.3	21.7/ 9.0/34.2
Subaru	Diesel	2	0 (1)	48	1.13	1.21	Unknown	21.3/ 10.1/33.2
Renault Nissan	Diesel	1.6	10	351	0.99	1.16	5.2/ 3.0/12.0	21.9 / 7.5/36.9

Table 5: List of the four highest NO_x emitting Euro 6 vehicle families as measured by remote sensing, compared with PEMS results.

142. The graph ranks the average NOx emission of the vehicles of different manufacturers, separated into Diesel and gasoline vehicles, measured on the road with the remote sensing compared to the EU NOx emission limit.

143. The FCA Group has the highest average NOx emissions of all OEMs for EU 6 vehicles in the remote sensing evaluation of the TRU Initiative. This result is in line with the PEMS measurements in different countries. The average NOx emission of the FCA group is with 1490 mg/km more than 18 times higher than the EU 6 emission limit (80 mg/km NOx) for Diesel cars. This result indicates a widespread use of defeat devices within the FCA group.

E. <u>Software analyses by the Researcher Group of Prof. Holz</u>

144. On February 2, 2016 FCA published a press release stating that FCA does not use defeat devices in the EU. In this the press release FCA denied any violation of the EU legislation.[12]

145. This was only 7 days before the DUH published their results (See above).

146. In May 2017 Holz et.al. published an analysis of defeat devices in modern automobiles. Beside the VW vehicles the group also checked the FIAT 500X. This car uses the same ECU (Bosch ECD17C69 P 1264 as VW. "Unlike the Volkswagen defeat device, the FCA mechanism relies on time only, reducing the frequency of NSC regenerations 26 minutes 40 seconds after engine start." Quote of the authors. They found homologation logic and a real driving logic block. "This means that regeneration requested by the homologation demand block will only be allowed to start a regeneration during the first 1600 seconds (26 minutes 40 seconds) of engine operation. After that, only NSC regeneration requested by the "real driving" logic will

[12]https://www.fcagroup.com/en-US/media_center/fca_press_release/FiatDocuments/2016/february/FCA_on_Real_Driving_Emissions.pdf.

be allowed to start regeneration. We note that this coincides with the runtime of standardized emissions test cycles." Quote of the authors.

147. **<u>This analysis of the researcher group of Prof. Holz proof the use of a defeat device in the EU 6 Fiat 500X.</u>**

F. <u>Violation of the EU Emission Regulations by FCA</u>

148. As my own testing and that of various other governments and organizations demonstrate, FCA's vehicles were in violation of EU emission regulations.

149. As discussed above, violations were evident at the emission testing in the laboratory as well as on-road testing. The vehicles emitted NOx emissions that greatly exceeded the limitations imposed by EU 5 and EU6.

150. Also the analysis of the software code of various FCA vehicles reveals the use of defeat devices by FCA

151. The EU regulation (EC) 715/2007 prohibits the use of a defeat device under normal use. The regulation defines in article 3, No. 10, what is a defeat device:

> "'defeat device' means any element of design which senses temperature, vehicle speed, engine speed (RPM), transmission gear, manifold vacuum or any other parameter for the purpose of activating, modulating, delaying or deactivating the operation of any part of the emission control system, that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and use."

152. This wording is very clear and precise. FCA used in different vehicles temperature sensors, engine speed sensors and timers to recognize if the vehicle is tested on laboratory dynometer. FCA has used a timer which switches the engine map just after the cold start emission test in the laboratory. This leads to extremely high NOx emissions. It also used a temperature sensor which changed the engine map just below the temperature window, in which

the certification test has to be performed. So, at temperatures lower than 19 degree C the emissions of FCA's vehicles go up drastically.

153. The use of such functions clearly fulfills the definition of a defeat device. The argument of FCA, that these changes are needed to protect the engines, is invalid. Other manufacturers are able to meet the NOx emission standards for diesel vehicles with well known technology. This technology can be bought from third party supplier such as Bosch or catalyst manufacturers such as Johnson Matthey. The only reason in my view why FCA has not used these efficient technologies is to save cost.

154. Examples of diesel vehicles of other manufactures with low NOX emissions can be found at the DUH web page under: https://www.duh.de/fileahttps://www.duh.de/fileadmin/user_upload/download/Projektinformation/Verkehr/dieselgate/EKI/180514_Tabelle_Phttps://www.duh.de/fileadmin/user_upload/download/Projektinformation/Verkehr/dieselgate/EKI/180514_Tabelle_PEMS-Messungen_Ergebnisse_Maerz_2016-Maerz_2018.pdfEMS-Messungen_Ergebnisse_Maerz_2016-Maerz_2018.pdfdmin/user_upload/download/Projektinformation/Verkehr/dieselgate/EKI/180514_Tabelle_PEMS-Messungen_Ergebnisse_Maerz_2016-Maerz_2018.pdf.

155. The best diesel models have much lower NOx emissions on the road than the EU 6 NOx emission limits, e.g. Audi A5, 2,0 l MJ 2016, 40 mg/km, Audi Q7, 3,0 l, MJ 2017, 26 mg/km, Mercedes E 220D, 2,0 l, MJ 2016, 44 mg/km, Mercedes, Mercedes E 200 2,0 MJ 2017, 43 mg/km,.

156. In the email of Aldo Marangoni, EMEA, FCA to the Robert Bosch GmbH from March 29, 2016 he stated:

> "More generally, it is a fact that no diesel engine can operate indefinitely under intensive EGR treatment or under intensive use regeneration events and that the operation of the EGR and of the NSC must be modulated to preserve the engine from damage and the occupants from safety risks, .. This why the current rules provide an exemption for AECS that are justified in terms of protecting the engine from damage and ensure safe operation of the vehicle."

Source: FCA_PIRNIK-001633 462_image.pdf

157. This is completely wrong. The EU regulation does not require indefinite operation but has a warranty period of 160.000 km within the vehicle has to meet the emission requirements for EU 6 vehicles. The argument that the OEM can switch off the abatement technology in order to have a longer life for the emission reduction parts, is baseless. If an OEM would have selected a not sustainable technology he has to repair the vehicle and he is not allowed to switch off emission reduction devices.

158. In the discussion in the EU working when drafting the regulation, ACEA, the EU car industry association came up with a statement: "You can't make us responsible for temperature of 40 degree C in Lapp land (Northern Finland) or the high altitude of the Gross Glockner pass in Austria".

159. After this statement the wording about "normal use" was inserted. The wording "normal use" is also used in the EU regulation for brakes and child seats. And of course nobody would argue that a brake does not need to function properly below 19 degree C.

G. <u>FCA's Statements Concerning Compliance with EU Emissions Regulations Were False and Misleading</u>

160. During the Class Period, FCA made a number of statements concerning its compliance with US emissions regulations.

161. For example, FCA's November 13, 2014 Form F-1A stated "Our vehicles and the engines that power them must also comply with extensive regional, national and local laws and

regulations and industry self-regulations (including those that regulate vehicle safety, end-of-life vehicles, emissions and noise). We are substantially in compliance with the relevant global regulatory requirements affecting our facilities and products. We constantly monitor such requirements and adjust our operations to remain in compliance." FCA also stated, "In combination with last generation exhaust gases after treatment systems, our diesel engine families comply with Euro 6 emission regulations, which are mandatory as of September 2014." These statements were repeated in FCA's November 26, 2014 F-1/A, 2014 20-F filed on March 5, 2015, prospectus on Form F-4 filed on May 19, 2015, and the press release and prospectus on Form 424B4 filed on June 17, 2015.

162. On September 22, 2015, FCA issued a press release stating "FCA U.S. does not use 'defeat devices.'"

163. During a January 27, 2016 earnings call, Sergio Marchionne stated "I think that after the advent of dieselgate, for a lack of a better term, FCA has undertaken a pretty thorough review and a thorough audit of its compliance teams. I think we feel comfortable in making the statement that there are no defeat mechanisms or devices present in our vehicles. And I think the cars perform in the same way on the road as they do in the lab under the same operating conditions. … We do have a best practice program to ensure that we calibrate and certify properly."

164. On February 2, 2016, FCA issued a press release, stating "In the past several months the issue of diesel emissions has been the subject of a great deal of attention, particularly in Europe, where diesel is quite common. In response to these events, FCA has conducted a thorough internal review of the application of this technology in its vehicles and has confirmed that its diesel engine applications comply with applicable emissions regulations. In particular:

FCA diesel vehicles do not have a mechanism to either detect that they are undergoing a bench test in a laboratory or to activate a function to operate emission controls only under laboratory testing. In other words, although emission levels vary depending on driving conditions, the emission control systems of the FCA vehicles operate in the same way under the same conditions, whether the vehicle is in a laboratory or on the road."

165. On February 29, 2016, FCA issued a press release and filed an Annual Report on Form 20-F with the SEC. On the issue of emissions, the 2015 20-F stated that FCA controlled for risks relating to regulatory compliance concerning emissions by "[e]valuat[ing] on-road versus laboratory testing to ensure compliance." Discussing various regulations in detail, the annual report went on to state "in light of recent issues in the automotive industry related to vehicle health-based emissions, we have taken action to extensively review compliance requirements. We conducted an audit of all current production software and emission calibrations. The audit revealed that all current production vehicle calibrations are compliant with applicable regulations and they appear to operate in the same way on the road as they do in the laboratory under the same operating conditions.

166. Under the heading "Automotive Emissions", the 2015 20-F provided detailed discussions of its regulatory obligations in Europe, stating, in part, "We must demonstrate that our vehicles will meet emission requirements and receive approval from the appropriate authorities before our vehicles can be sold in EU Member States. The regulatory requirements include random testing of newly assembled vehicles and a manufacturer in-use surveillance program. EU and UNECE requirements are equivalent in terms of stringency and implementation. In 2011, updated standards for exhaust emission by cars and light-duty trucks, called Euro 5, became effective. Impending European emission standards focus particularly on

further reducing emissions from diesel vehicles. The new Euro 6 emission levels, effective for all passenger cars on September 1, 2015 (one year later for light commercial vehicles). . .” The 2015 20-F also stated, “We manufacture and sell our products and offer our services around the world. [sic] with requirements relating to reduced emissions, increased fuel economy, . . . Our vehicles and the engines that power them must also comply with extensive regional, national and local laws and regulations and industry self-regulations (including those that regulate emissions certification, end-of-life vehicles and the chemical content of our parts, noise, and worker health and safety). In addition, vehicle safety regulations are becoming increasingly strict. We are substantially in compliance with the relevant global regulatory requirements affecting our facilities and products. We constantly monitor such requirements and adjust our operations and processes to remain in compliance.”

167. On May 23, 2016, it was reported that several tests by the German motor transport authority KBA had found evidence that the exhaust treatment system in some of FCA’s models would switch itself off after 22 minutes, which is just 2 minutes after the standard 20 minute emissions test. This was similar to the scheme conducted by Volkswagen where its defeat devices turned themselves off after 23 minutes to cheat the emissions tests. The German tests found a special NOx catalyst which is being switched off after a few cleaning cycles. This shut down caused NOx to be released into the atmosphere at more than 10 times the permitted level. A German newspaper, the Bild am Sonntag reported that Germany’s Federal Motor Transportation Authority determined that FCA allegedly used illegal software to manipulate emissions controls. In response to this news, a spokesman for FCA stated “all its vehicles are compliant with existing emissions rules.”

168. The above statements made by FCA were false and misleading for the reasons discussed in detail above.

169. My work in this matter is ongoing. My opinions in this Report are subject to refinement or revision based on analysis of new information which may be provided to me, including the opinions of other experts and receipt of additional documents and information, and based on further analysis of the information and materials described herein. Should additional relevant information be provided to me, my opinions may be supplemented at a later date.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on August 15, 2018, at Berlin, Germany.

Axel Friedrich

Dr. Axel Friedrich

Exhibit 1

CV

- Technical Chemistry, Technical University of Berlin. Dipl.- Ing 1972.
- Doctoral thesis at University of Paderborn, in field of reactor modelling, 1979.
- Federal Environment Agency of Germany Umweltbundesamt (UBA) for more than 28 years
- Head of Environment, Transport and Noise (1994-2008).
- Federal Environment Agency of Germany Umweltbundesamt (UBA) head of "Marine Environmental Protection" of the Agency (1992-1994).
- Federal Environment Agency of Germany Umweltbundesamt (UBA) head of Refineries, Fuels and Reduction of Organic Compounds (1990-1992).
- Federal Environment Agency of Germany Umweltbundesamt (UBA) officer in the section "Reduction of Air Pollution from Traffic" 1980-1990.
- Founding member of ICCT (International Council for Clean Transport). 2001
- Former Chairman of the OECD working group on transport – 2005- 2008.
- Consultant Chemist and Engineer 2008 to present. I am working on emission control regulation on road and off road sector, climate change impact from the transport sector, CO_2 emission regulation, fuel regulation etc.
- Special interest: Sustainable Transport, Climate Gas Reduction, non-regulated emissions, fuel influence on the emissions, bio fuels. "OECD: Environmental Sustainable Transport", "Environmental Impact of globalisation", First eco balance on bio fuels

Exhibit 2

Listing of cases in which I have testified as an expert at trial or by deposition during the past four years

a. Volkswagen and Audi Class Actions, Federal court of Australia Proceedings NSD1307 and 1308 of 2015 Sydney Australia

b. DUH against the Land Baden- Württemberg, Administration court Stuttgart 28.07.2017

c. DUH against the Land North- Rhine- Westphalia, Administration court Düsseldorf 13.09.2016

Exhibit 3

A listing of all publications that I have authored or co-authored within the preceding ten years

a. Critical Reflection of the European CO2 Targets Integer Emissions summit AdBlue Forum Europe, Brussels, June 2018

b. The Truth is on the Road "Real Driving emissions" 22.ETH-Conference on Combustion Generated Nanoparticles Zurich, June 2018.

c. Die Lösung liegt in der Neuordnung der Mobilität, Architektenkongress 2018, Rotterdam, May 2018.

c. Der Diesel Skandal: Ein Staatsversagen Offene Akademie, Gelsenkirchen, March 2019

d. The Truth is on the Road, Fisita world Summit 2017, Geneva, November 2017

e. Diesel Gate- Ein Insider berichtet. Fachzentrum Verkehr der Bergischen Universität Wuppertal und Bezirksvereinigung Berg und Mark (BV BuM) der Deutschen Verkehrswissenschaftlichen Gesellschaft (DVWG) , Wuppertal, December 2017.

f. Mobility and Pollution; current Challenges and Implications for the Citizens, Conference for the EU Commission Staff, November 2017,

g. Zukünftiges Zulassungsverfahren für Pkw in Europa, Daimler Sustainibility Dialogue Stuttgart November 2016

h. International Best Practices in Fuel Economy Policy. Labeling and Fiscal Incentives, International Workshop on "Developing Applied Fuel Economy Policy, South Tangerang, Indonesia, August 2016.

i. Holzheizung- Ein unterschätztes Umweltproblem, EPP Round Table, EU Parliament, Brussels, Belgium, June 2017

j. Transport Emissions after COP21, keynote on the 5th EU-US Symposium on „Decarbonising transport for a sustainable future", Washington, USA May 2017.

k. Contribution from a NGO Perspective, SAE 2017 On- Board Diagnostics Symposium-Europe, Turin, February 2017.

l. Emerging Issues in Real World Emissions, Better Air Quality Conference, Busan September 2016.

m. On Road Vehicle Emissions and Effect on Human Health, WLPGA Autogas Summit. Seoul South Corea , January 2015.

n. Taxi Measurements, 6th Vert Forum, Duebendorf, Switzerland. March 2915.

o. Challenges of Black Carbon- Mitigation in Europe, Better Air Quality Conference 2014, Colombo Sri Lanka, November 2014,

p. Maritime Fuels, Better Air Quality Conference 2014, Colombo Sri Lanka, November 2914.

q. Overview of Fuel Economy Standards and its Policy Options, Public dialogue, Jarkarta, November 2014.

Exhibit 4

A listing of material that I considered in formation of my opinions

a. https://www.umweltbundesamt.de/no2-krankheitslasten

b. https://cordis.europa.eu/result/rcn/45302_en.html

c. https://en.wikipedia.org/wiki/European_emission_standards#Emission_standards_for_trucks_and_buses

d. https://www.umweltbundesamt.de/presse/pressemitteilungen/finale-daten-zur-no2-belastung-2017-verfuegbar

e. https://www.eea.europa.eu/media/newsreleases/many-europeans-still-exposed-to-air-pollution-2015/premature-deaths-attributable-to-air-pollution

f. Schematic representation of a high-speed passenger car EGR/intake throttle system, Ritter, H-J., O. Mann, 1999. "Das Kühlmodul für den V8-TDI-Motor von Audi", ATZ/MTZ-Sonderausgabe, 60 (99)

g. https://www.theicct.org/sites/default/files/publications/ICCT_NOx-control-tech_revised%2009152015.pdf

h. https://en.wikipedia.org/wiki/Selective_catalytic_reduction

i. https://en.wikipedia.org/wiki/NOx_adsorber

j. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32007R0715

k. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:32008R0692

l. https://www.theicct.org/publications/defeat-devices-under-us-and-eu-passenger-vehicle-emissions-testing-regulations

m. https://www.theicct.org/blogs/staff/why-are-eu-automakers-claiming-defeat-devices-are-not-defeat-devices

n. https://www.bmvi.de/SharedDocs/EN/publications/bericht-untersuchungskommission-volkswagen.html

o. https://carbuzz.com/news/german-regulators-find-an-emissions-defeat-device-on-fiat-500x

p. https://www.autocar.co.uk/car-news/industry/fiat-accused-defeat-device-use-500x

q. https://www.express.co.uk/news/world/805798/European-Union-emissions-scandal-Italy-Fiat-Chrysler-Volkswagen

r. https://www.gruene-bundestag.de/fileadmin/media/gruenebundestag_de/themen_az/verkehr/PDF/Gutachten_Abschalteinrichtungen

s. https://www.bundestag.de/blob/481344/c6f582c8598c9d6b62fcfb2acd012462/stellungnahme-prof--dr--fuehr--sv-4--data.pdf

t. http://www.duh.de/uploads/media/Rechtsgutachten_Klinger_Abschalteinrichtungen.pdf

u. http://www2.developpement-durable.gouv.fr/IMG/pdf/Rapport_Commission_independante.pdf

v. https://euobserver.com/dieselgate/138471

w. https://www.rdw.nl/-/media/rdw/rdw/pdf/sitecollectiondocuments/over-rdw/rapporten/rdw-emission-test-programme-english.pdf

x. http://www.emissieregistratie.nl/erpubliek/documenten/Lucht%20(Air)/Verkeer%20en%20Vervoer%20(Transport)/Wegverkeer/TNO%20(2016)%20Assessment%20of%20road%20vehicle%20emissions%20-%20methodology.pdf

y. https://www.reuters.com/article/us-volkswagen-emissions-netherlands/jeep-suzuki-may-have-violated-emissions-rules-dutch-watchdog-idUSKBN19V1EL

z. https://www.duh.de/fileadmin/media/news_import/B449_DUH_FIAT_500X_unofficial_translation_EN_01.pdf

aa. https://www.transportenvironment.org/news/fiat-modify-engines-after-tests-show-%E2%80%98extreme%E2%80%99-nox-levels

bb. https://www.duh.de/presse/pressemitteilungen/pressemitteilung/deutsche-umwelthilfe-stellt-mehr-als-20-fach-erhoehte-stickoxid-emissionen-bei-einem-getesteten-fiat/

cc. https://www.duh.de/presse/pressemitteilungen/pressemitteilung/deutsche-umwelthilfe-fordert-sofortigen-verkaufsstopp-fuer-den-fiat-500x-multijet-und-alle-weitere-d/

dd. https://www.duh.de/fileadmin/user_upload/download/Projektinformation/Verkehr/dieselgate/EKI/180514_Tabelle_PEMS-Messungen_Ergebnisse_Maerz_2016-Maerz_2018.pdf

ee. https://www.duh.de/presse/pressemitteilungen/pressemitteilung/deutsche-umwelthilfe-enthuellt-schmutzigste-italienische-franzoesische-und-deutsche-diesel-pkw-mit/

ff. https://www.duh.de/presse/pressemitteilungen/pressemitteilung/fiat-chrysler-deutschland-erkennt-noch-anhaengigen-klageanspruch-der-deutschen-umwelthilfe-wegen-irr/

gg. https://www.duh.de/presse/pressemitteilungen/pressemitteilung/deutsche-umwelthilfe-verklagt-fiat-chrysler-deutschland-wegen-irrefuehrender-werbeaussagen-zum-fiat-5/

hh. https://www.duh.de/presse/pressemitteilungen/pressemitteilung/deutsche-umwelthilfe-mahnt-fiat-ab-und-beantragt-vor-dem-landgericht-darmstadt-den-erlass-einer-eins/

ii. https://www.theicct.org/sites/default/files/TRUE_vehicle_rating_factsheet_20180604_0.pdf

jj. https://www.transportenvironment.org/press/fiat-given-special-treatment-italian-dieselgate-investigators-report-reveals

kk. https://www.transportenvironment.org/news/eu-oversight-vehicle-testing-gaining-support-fiat-fiasco-revealed

ll. T. Holz et al. "How we did it:An analysis of emission defeat devices in modern automobiles". http://syssec.rub.de/research/publications/defeat-devices/

Exhibit 5

List of FCA vehicles tested by DUH under my supervision

FCA EU 6 Diesel-cars tested	Day of first registration	Power in kW	Egine volume in ccm	Emission control device	Kilometer
Fiat 500X 1.6	02.2016	88	1.598	LNT, EGR, DPF	2.627
Fiat 500X 1.6 (actual software status May 2017)	09.2016	88	1.598	LNT, EGR, DPF	6.684
Fiat 500X 2.0	06.2016	103	1.956	LNT, EGR, DPF	17.613
Jeep Renegade 1.6 Multijet (vehicle color red)	02.2016	88	1.598	LNT, EGR, DPF	3.878
Jeep Renegade 1.6 Multijet (vehicle color black)	02.2016	88	1.598	LNT, EGR, DPF	8.698